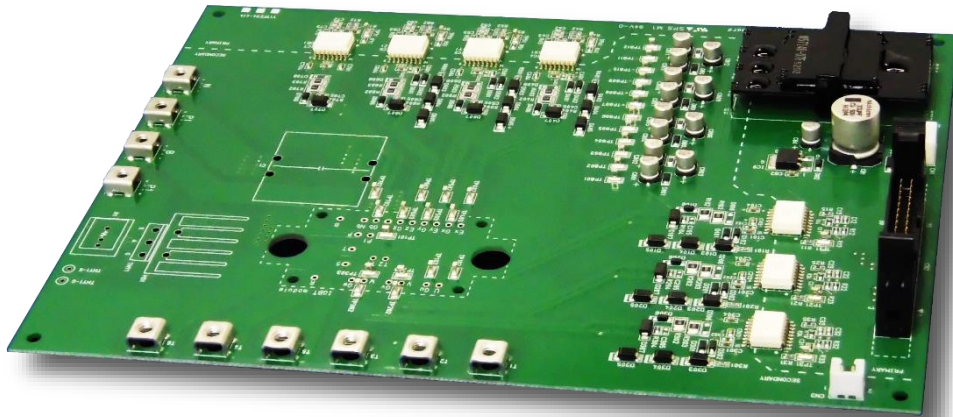


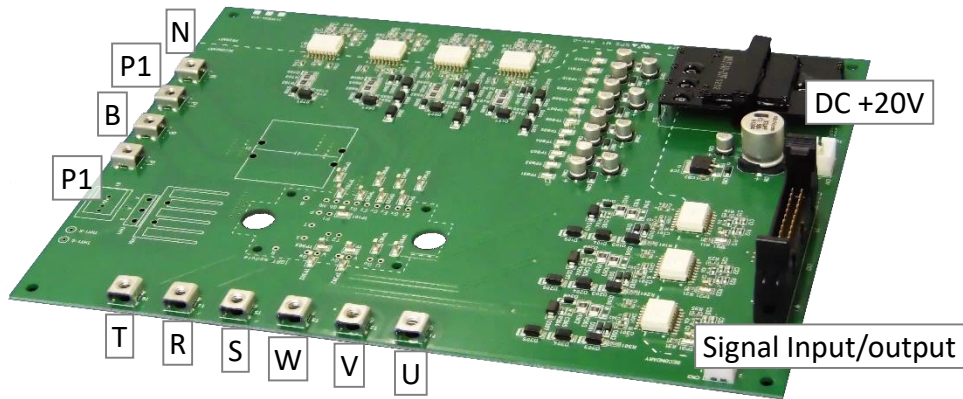
Small PIM module (M728/M732) Evaluation Board



September, 2022

Device Application Technology Dept.
Sales Div., Electronic Devices Business Gr.
Fuji Electric Co., Ltd.

Evaluation Board for M728/M732



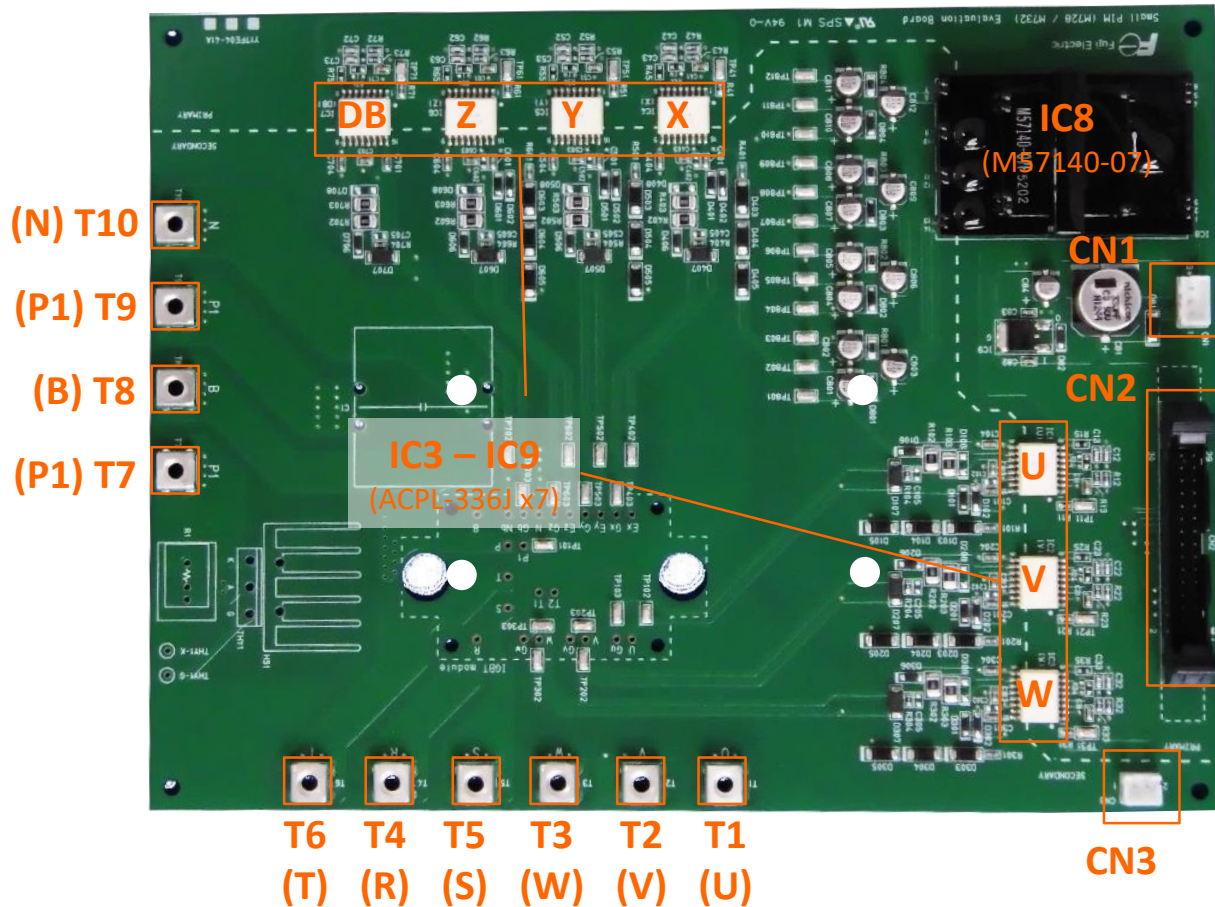
220mm x 165mm

- ✓ On-board isolated DC/DC power supply
- ✓ Broadcom (Avago) ACPL-336J driver IC
Integrated fail-safe IGBT protection
 - Desaturation detection, “Soft” IGBT turn-off and fault feedback
 - Under Voltage Lock Out (UVLO) protection with feedback
- ✓ +5V CMOS level for PWM and fault signals
- ✓ $V_{GE} = +15V/-6V$ gate drive
- ✓ We can provide the circuit diagram, PCB pattern, BOM to support your driver design

Supported modules : Small PIM (M728/M732) solder pins modules

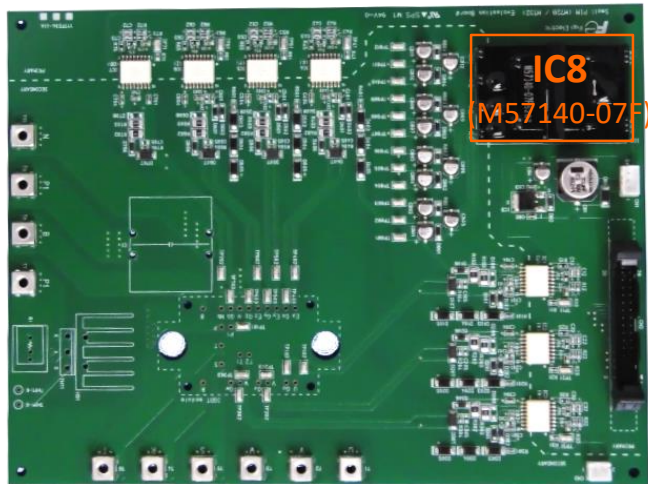
(V series) 7MBR10VKC060-50, 7MBR15VKC060-50, 7MBR20VKC060-50
7MBR30VKC060-50, 7MBR10VKC120-50, 7MBR15VKC120-50
(X series) 7MBR10XKC065-50, 7MBR15XKC065-50, 7MBR20XKC065-50
7MBR30XKC065-50, 7MBR10XKC120-50, 7MBR15XKC120-50
7MBR25XKC120-50

Layout of the Evaluation Board



- IC1 – IC7:** Gate driver IC
ACPL-336J
- IC8:** DC/DC power supply
- CN1:** Power supply connector
(DC +20V)
- CN2:** Gate PWM signal input/
Fault signal output
- CN3:** NTC output
- T1 – T3:** 3φ AC output terminal
- T4 – T6:** 3φ AC input terminal
- T7,T9:** DC+ terminal
- T8:** Brake terminal
- T10:** DC- terminal

(1) Attach IC8 (M57140-07F)

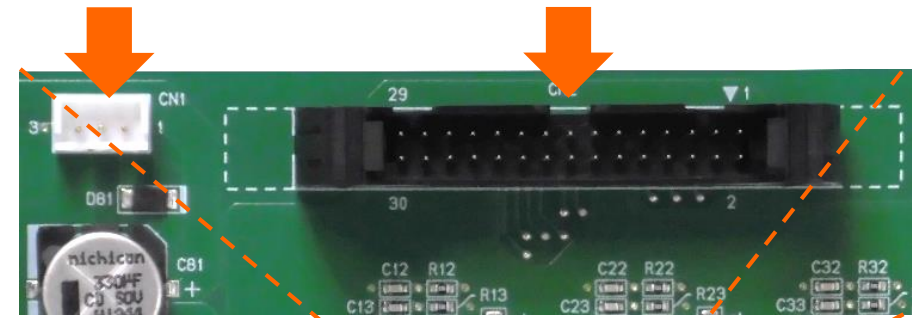


For reverse bias less voltage supply use M57140-01F

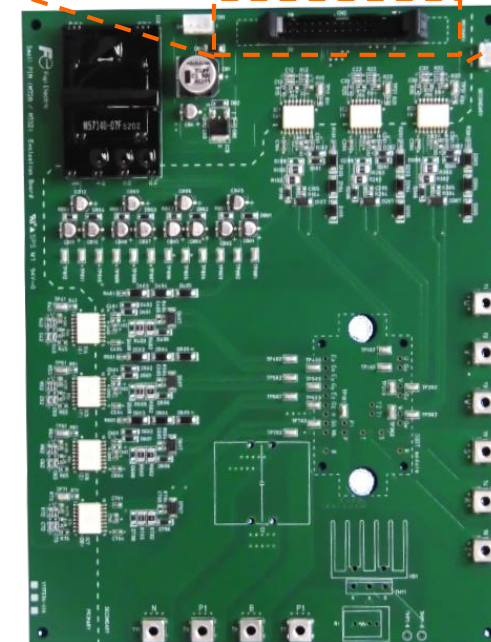
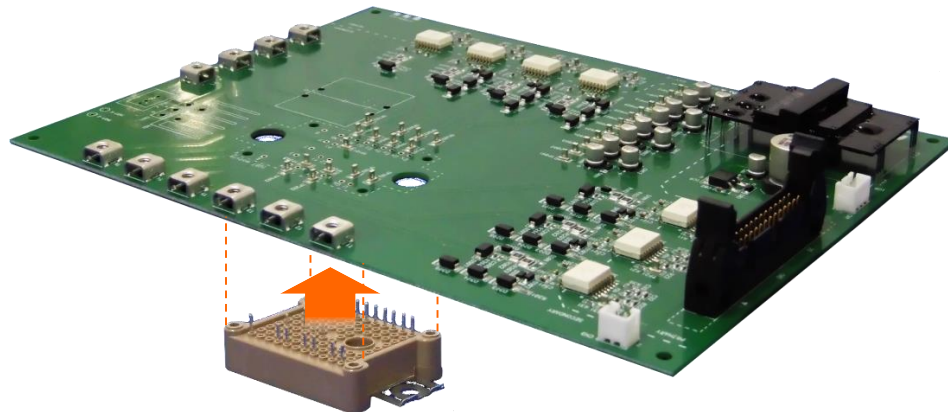
(3) Connect I/O signal and DC power supply

CN1: 20V (DC)

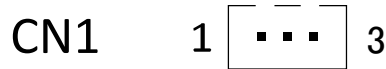
CN8: I/O signal



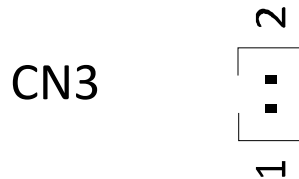
(2) Attach and solder IGBT module to PCB



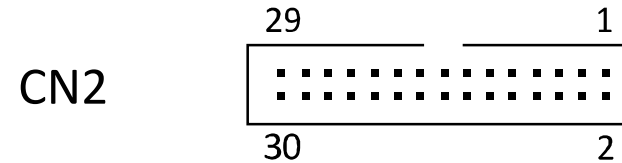
I/O Pin Assignments



PIN No.	Pin name	Function
1	VDC_IN	+20V
2	NC	NC
3	GND	GND



PIN No.	Pin name	Function
1	T1	T1
2	T2	T2



PIN No.	Pin name	Function
1	IN-DB	PWM signal for B phase
2	NC	
3	IN-X	PWM signal for X phase
4	IN-U	PWM signal for U phase
5	IN-Y	PWM signal for Y phase
6	IN-V	PWM signal for V phase
7	IN-Z	PWM signal for Z phase
8	IN-W	PWM signal for W phase
9 - 12	GND	
13	FAULT-DB	DESAT fault output for B phase
14	UVLO-DB	Undervoltage lockout output for B phase
15	FAULT-U	DESAT fault output for U phase
16	UVLO-U	Undervoltage lockout output for U phase
17	FAULT-V	DESAT fault output for V phase
18	UVLO-V	Undervoltage lockout output for V phase
19	FAULT-W	DESAT fault output for W phase
20	UVLO-W	Undervoltage lockout output for W phase
21	FAULT-X	DESAT fault output for X phase
22	UVLO-X	Undervoltage lockout output for X phase
23	FAULT-Y	DESAT fault output for X phase
24	UVLO-Y	Undervoltage lockout output for Y phase
25	FAULT-Z	DESAT fault output for X phase
26	UVLO-Z	Undervoltage lockout output for Z phase
27 - 30	GND	

Description	Parameter	Value	Unit	Remarks
DC input voltage for DC/DC converter	$V_{DC(in)}$	18 ~ 22	V	Recommended value: 20V
DC output voltage of DC/DC converter	V_{out1}	+15/-6	V	Gate-Emitter voltage
Primary side control voltage	V_{out2}	5	V	Non-isolation
PWM signal input voltage	V_{IN}	0 / +5	V	
Peak output current	$I_{O(peak)}$	2.5	A	Follow the specification of ACPL-336J
Peak output current for gate drive per IGBT	$I_{O(peak)}$	2.5	A	Follow the specification of ACPL-336J
Operating temperature	T_{opr}	-10... +75	°C	
Storage temperature	T_{stg}	-20... +85	°C	
FAULT output current	I_{FAULT}	10	mA	Follow the specification of ACPL-336J
FAULT pin voltage	V_{FAULT}	5	V	Follow the specification of ACPL-336J
FAULT logic low output current	I_{FAULT_L}	9.0	mA	Follow the specification of ACPL-336J
UVLO output current	I_{UVLO}	10	mA	Follow the specification of ACPL-336J
UVLO pin voltage	V_{UVLO}	5	V	Follow the specification of ACPL-336J
UVLO threshold low to high	V_{UVLO+}	12.5	V	Follow the specification of ACPL-336J
UVLO threshold high to low	V_{UVLO-}	11.3	V	Follow the specification of ACPL-336J
DESAT detection threshold	V_{DESAT}	7	V	Follow the specification of ACPL-336J
Output Mute Time due to DESAT	$t_{DESAT(MUTE)}$	3.0	ms	Follow the specification of ACPL-336J
Time Input Kept Low Before Fault Reset to High	$t_{DESAT(RESET)}$	3.0	ms	Follow the specification of ACPL-336J

Please refer to datasheet of ACPL-336J and M57140-07F for other characteristics.

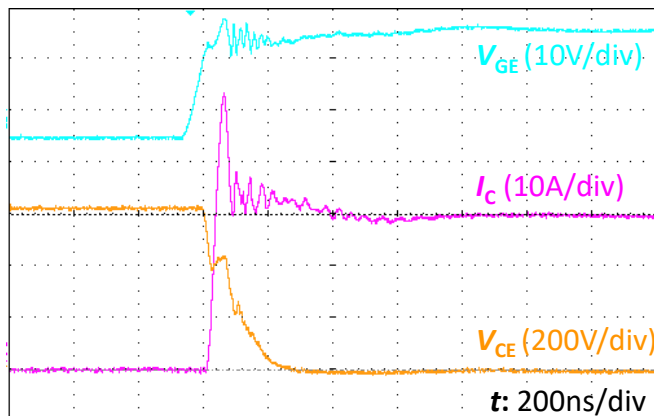
Example of Switching Waveform

Test condition:

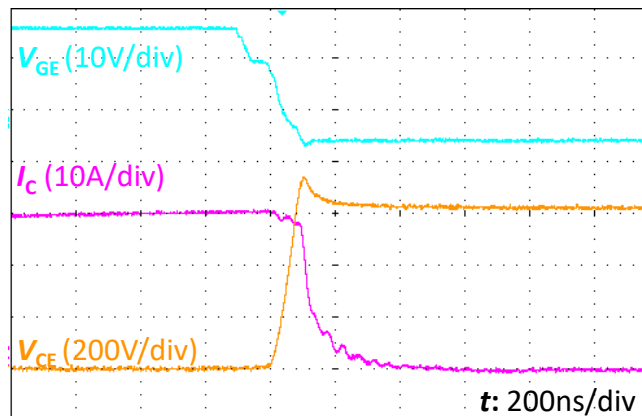
Module: 7MBR15VKC120-50

$V_{CC}=600V$, I_C , $I_F=30A$, $R_G=39\Omega$, $V_{GE}=+15V/-6V$, $T_{vj}=R.T.$

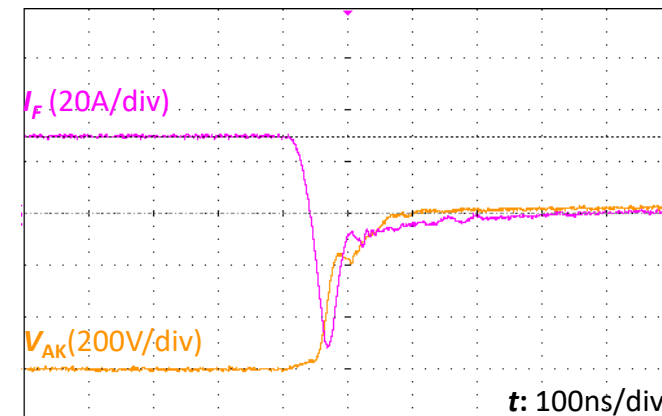
Turn on



Turn off



Reverse Recovery



The initial value of R_G is 15 Ω .

Before measurement, please decide R_G value of test module by specification.

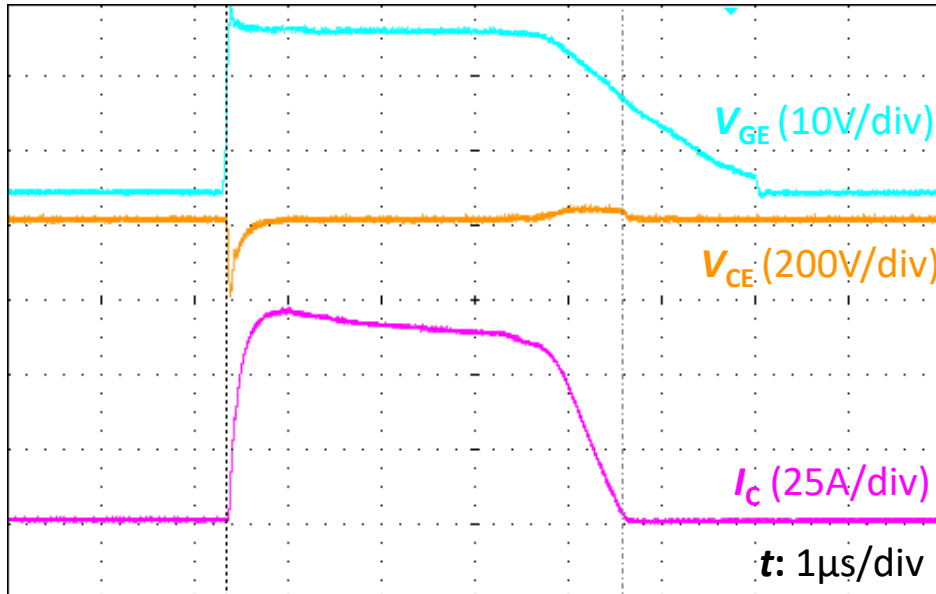
Short Circuit Protection (DESAT)

Test condition:

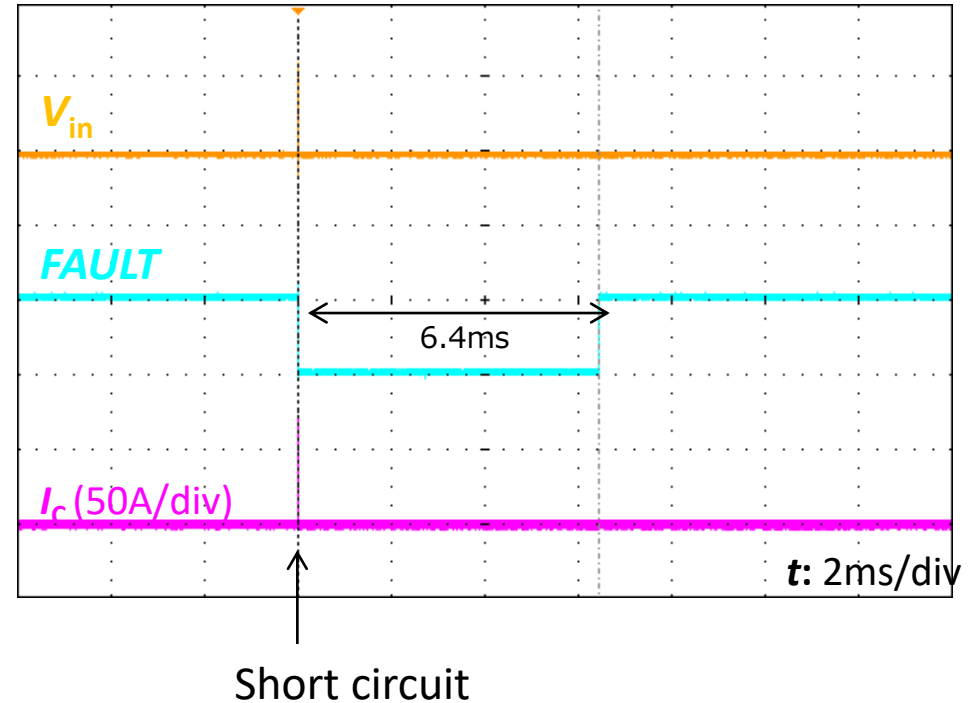
Module: 7MBR15VKC120-50

$V_{CC}=800V$, $R_G=39\Omega$, $V_{GE}=+15V/-6V$, $T_{vj}=R.T.$

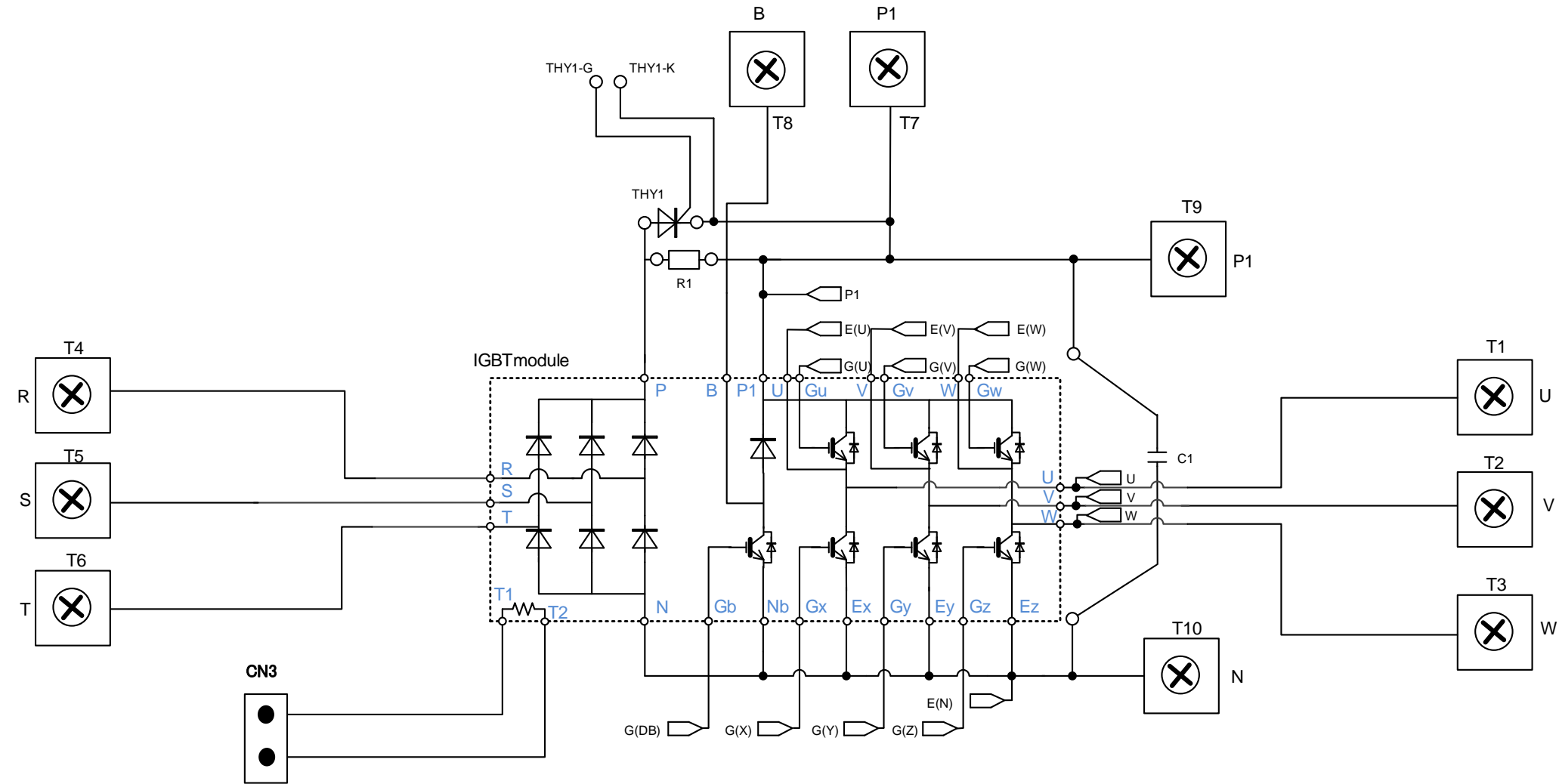
Short circuit waveforms



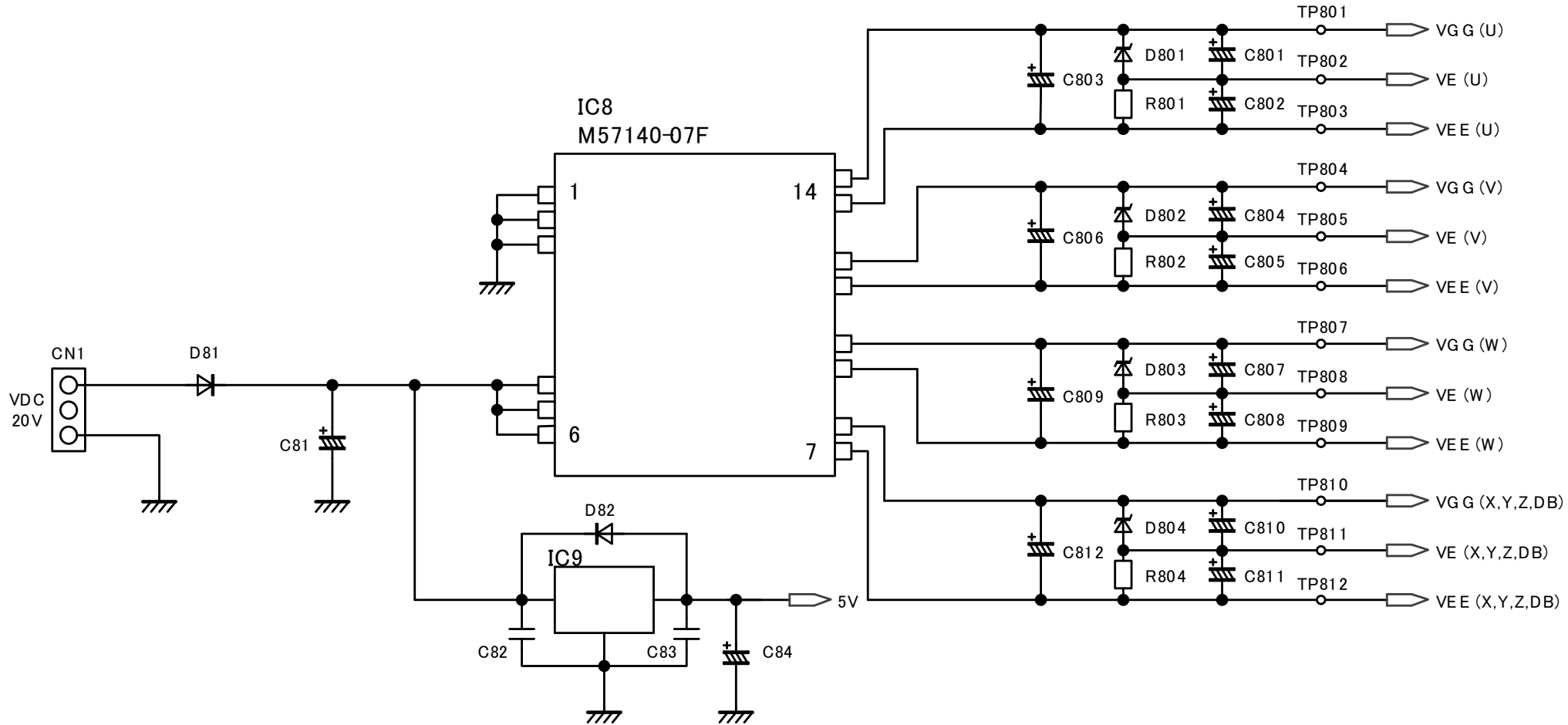
FAULT signal output



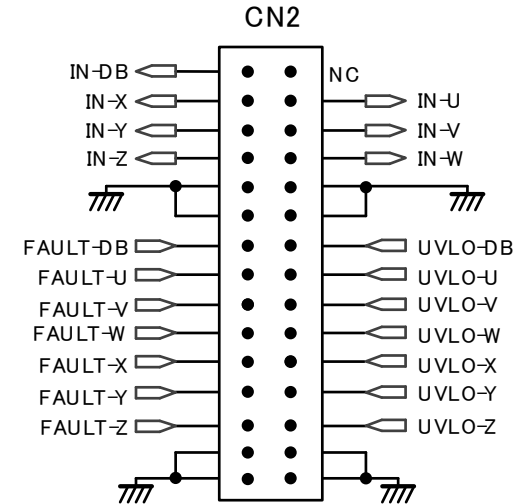
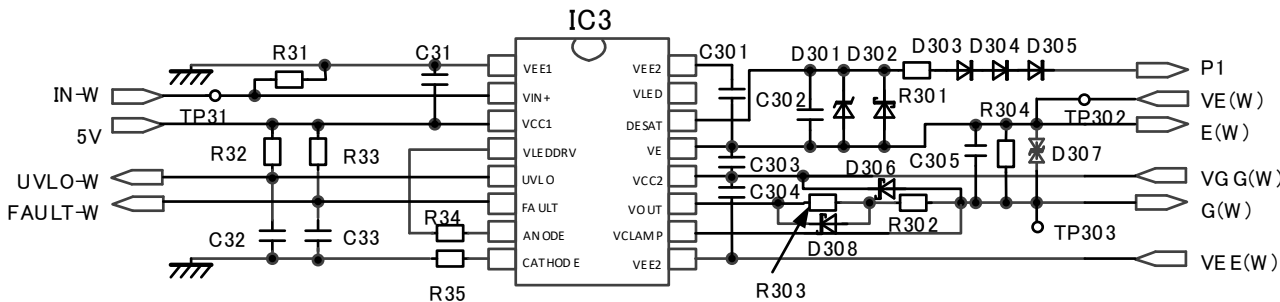
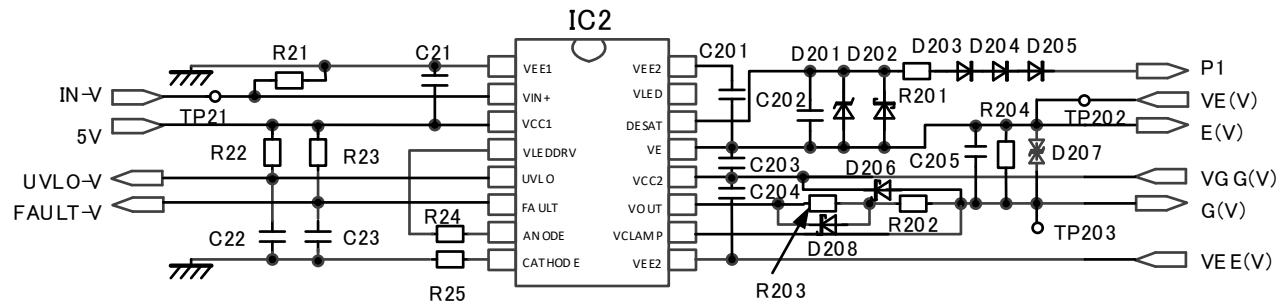
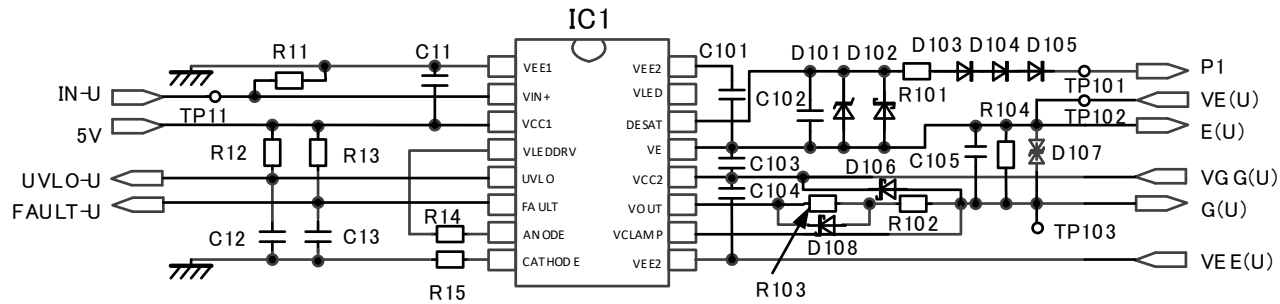
Circuit Diagram (Main Circuit)



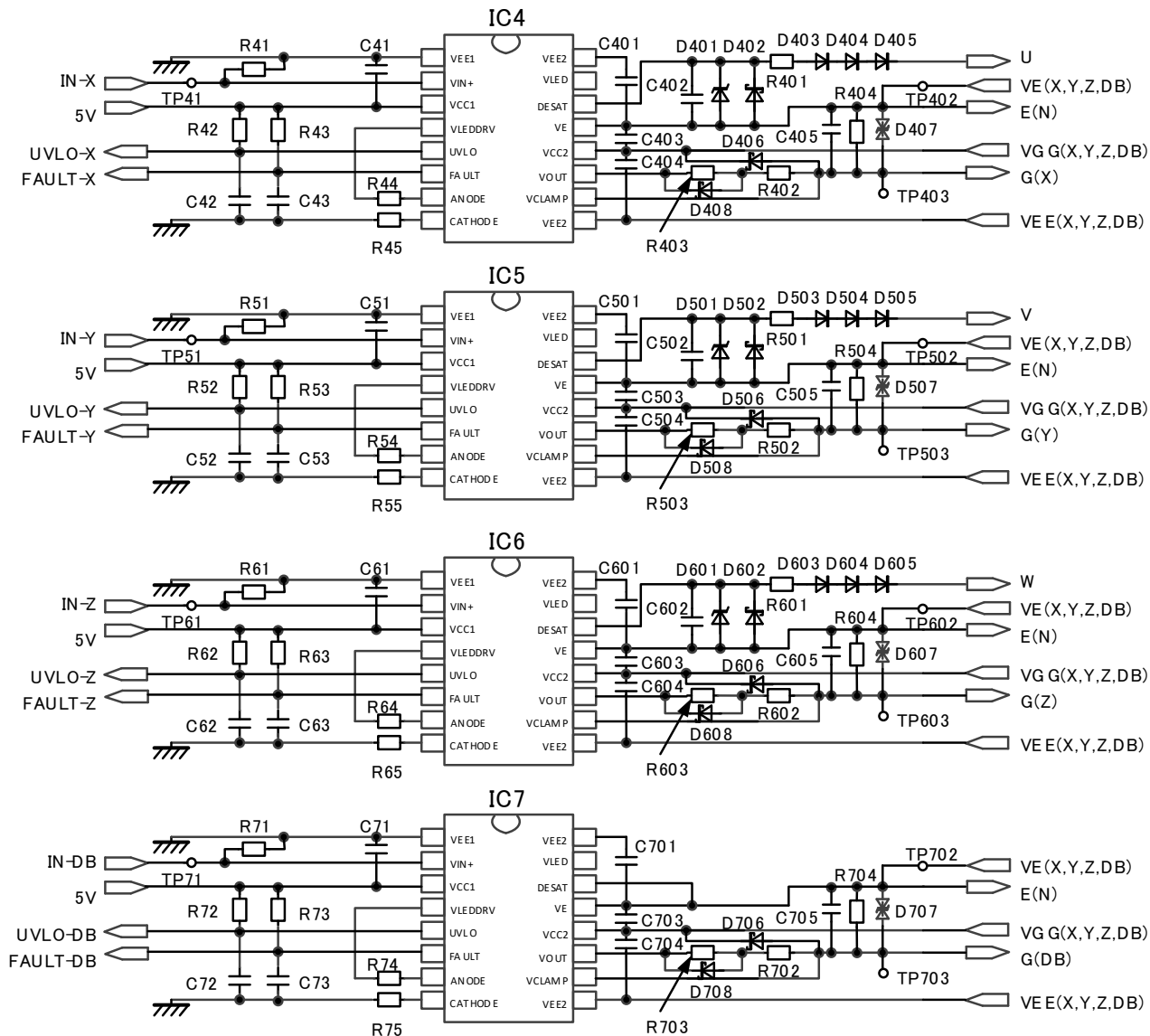
Circuit Diagram (DC/DC Power Supply)



Circuit Diagram (Gate Drive) (1/2)



Circuit Diagram (Gate Drive) (2/2)

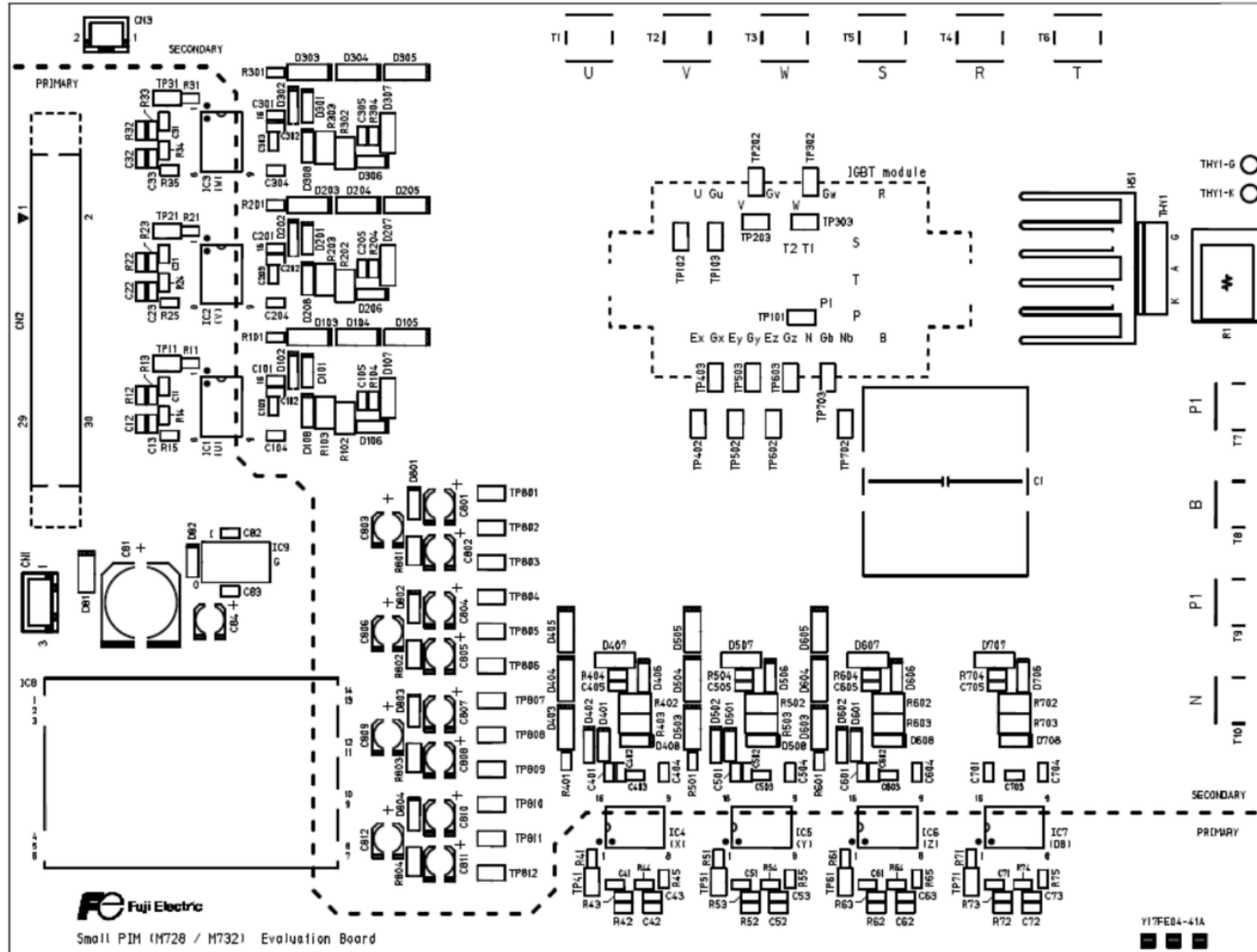


Bill of Material

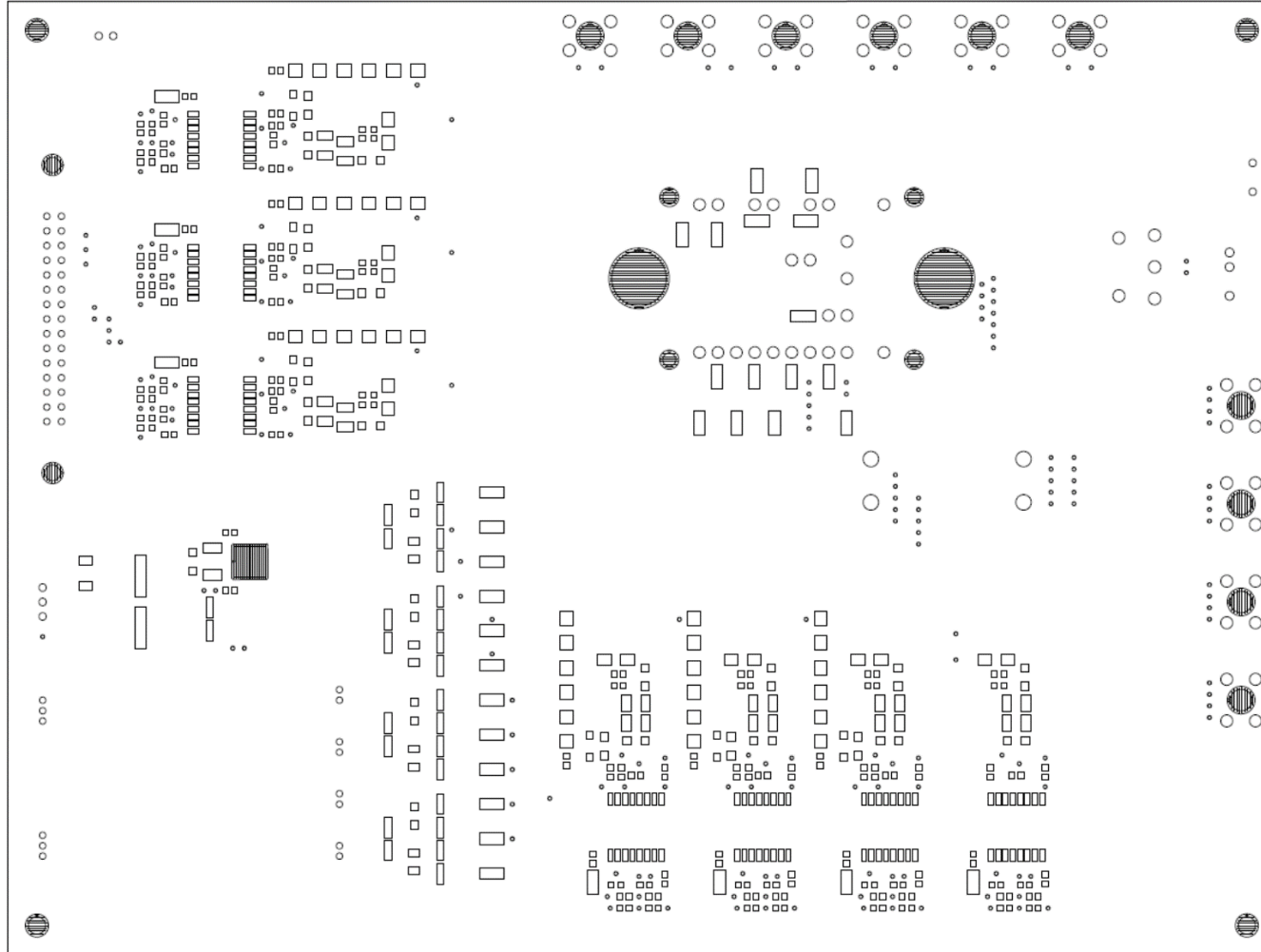
Component		Qty.	Value	Package	Manufacturer	Note
Resistor	R1	0	5W	WF5N		NC
	R11 R12 R13 R21 R22 R23 R31 R32 R33 R41 R42 R43 R51 R52 R53 R61 R62 R63 R71 R72 R73 R104 R204 R304 R404 R504 R604 R704	28	10k Ω , 1/10W	1608		
	R14 R15 R24 R25 R34 R35 R44 R45 R54 R55 R64 R65 R74 R75	14	150 Ω , 1/10W	1608		
	R101 R201 R301 R401 R501 R601	6	1k Ω , 1/10W	1608		
	R103 R203 R303 R403 R503 R603 R703	7	0k Ω , 1/2W	3225		Gate resistance: R_G
	R102 R202 R302 R402 R502 R602 R702	7	15 Ω , 1/2W	3225		Gate resistance: R_G
	R801 R802 R803 R804	4	4.7k Ω , 1/4W	3216		
	C1	0	FHACE1C2N684J2A250			NC
	C12 C13 C22 C23 C32 C33 C42 C43 C52 C53 C62 C63 C72 C73	14	330pF, 50V			
	C11 C21 C31 C41 C51 C61 C71 C101 C103 C104 C201 C203 C204 C301 C303 C304 C401 C403 C404 C501 C503 C504 C601 C603 C604 C701 C703 C704	28	1 μ F, 50V			
C102 C202 C302 C402 C502 C602	6	470pF, 50V			Cblank	
C81	1	330 μ F, 50V	ϕ 12.5 x 14.5			
C84 C801 C802 C803 C804 C805 C806 C807 C808 C809 C810 C811 C812	13	22 μ F, 25V	ϕ 5 x 6			
C105 C205 C305 C405 C505 C605 C705	7		1608		NC	
C82 C83	2	0.1 μ F, 50V				

Bill of Material (Cont'd)

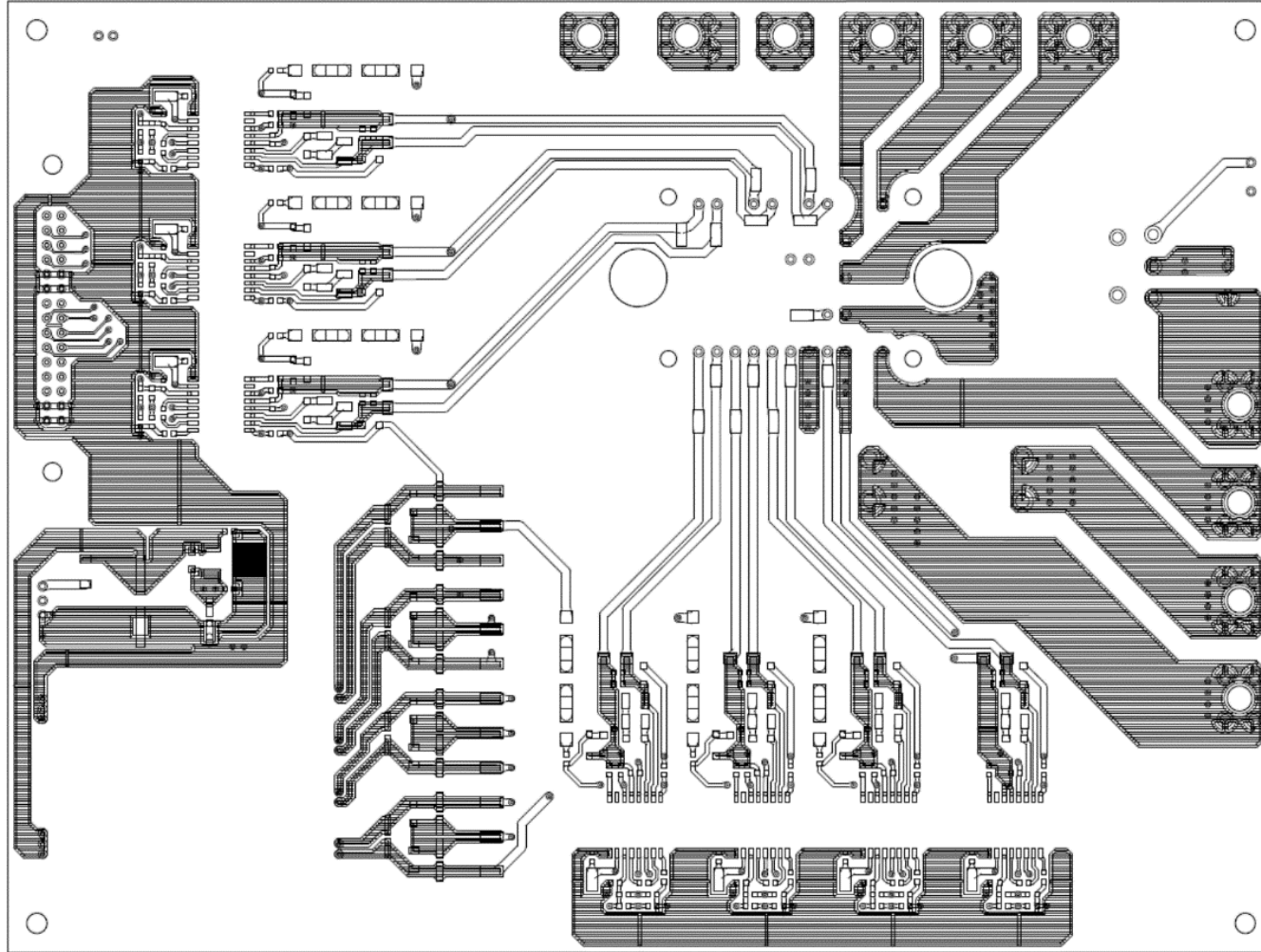
Component							Qty.	Value	Package	Manufacturer	Note
SBD	D82 D606	D106 D706	D206	D306	D406	D506	8	40V, 1A CRS04			
Diode	D103 D303 D503	D104 D304 D504	D105 D305 D505	D203 D403 D603	D204 D404 D604	D205 D405 D605	18	600V, 1A US1J	DO-214AA		
SBD	D81						1	40V, 5A	PMEG4050EP		
SBD	D102	D202	D302	D402	D502	D602	6	40V, 0.5A MBR0540	SOD-123		
TVS Diode	D107 D707	D207	D307	D407	D507	D607	7	20.5V, 60A SMAJ20CA	DO-214AC		
Zener Diode	D101	D201	D301	D401	D501	D601	6	10V, 1.5W 1N5925A	DO-41		
ZD	D801	D802	D803	D804			4	1W, 14.25-15.75V DZ2W15000L			
SBD	D108 D708	D208	D308	D408	D508	D608	7	CRS10I40A	SOD-123		NC
Thyristor	Thy1						0	VS-40TPS16-M3	TO-247		NC
IC	IC8						1	M57140-07F		Isahaya Electronics	
	IC9						1	TA7805F			
	IC1, IC7	IC2	IC3	IC4	IC5	IC6	7	ACPL-336J		Broadcom (AVAGO Technologies)	
Connector	CN1						1	B3B-XH-A(LF)(SN)	3p		
	CN2						1	XG4A-3031	30p		
	CN3						1	B2B-XH-A(LF)(SN)	2p		
Terminal	T1, T7,	T2, T8,	T3, T9,	T4, T10,	T5,	T6,	12	PCB-9 M4			
Test Pin	TP11 TP71 TP203 TP403 TP603 TP804 TP807 TP810	TP21 TP101 TP301 TP501 TP702 TP805 TP808 TP811	TP31 TP102 TP302 TP502 TP703 TP806 TP809 TP812	TP41 TP103 TP303 TP503 TP801 TP807	TP51 TP201 TP401 TP601 TP802 TP808	TP61 TP202 TP402 TP602 TP803 TP809	39	HK-2-S			
PCB	Y17FE04-41A						1				



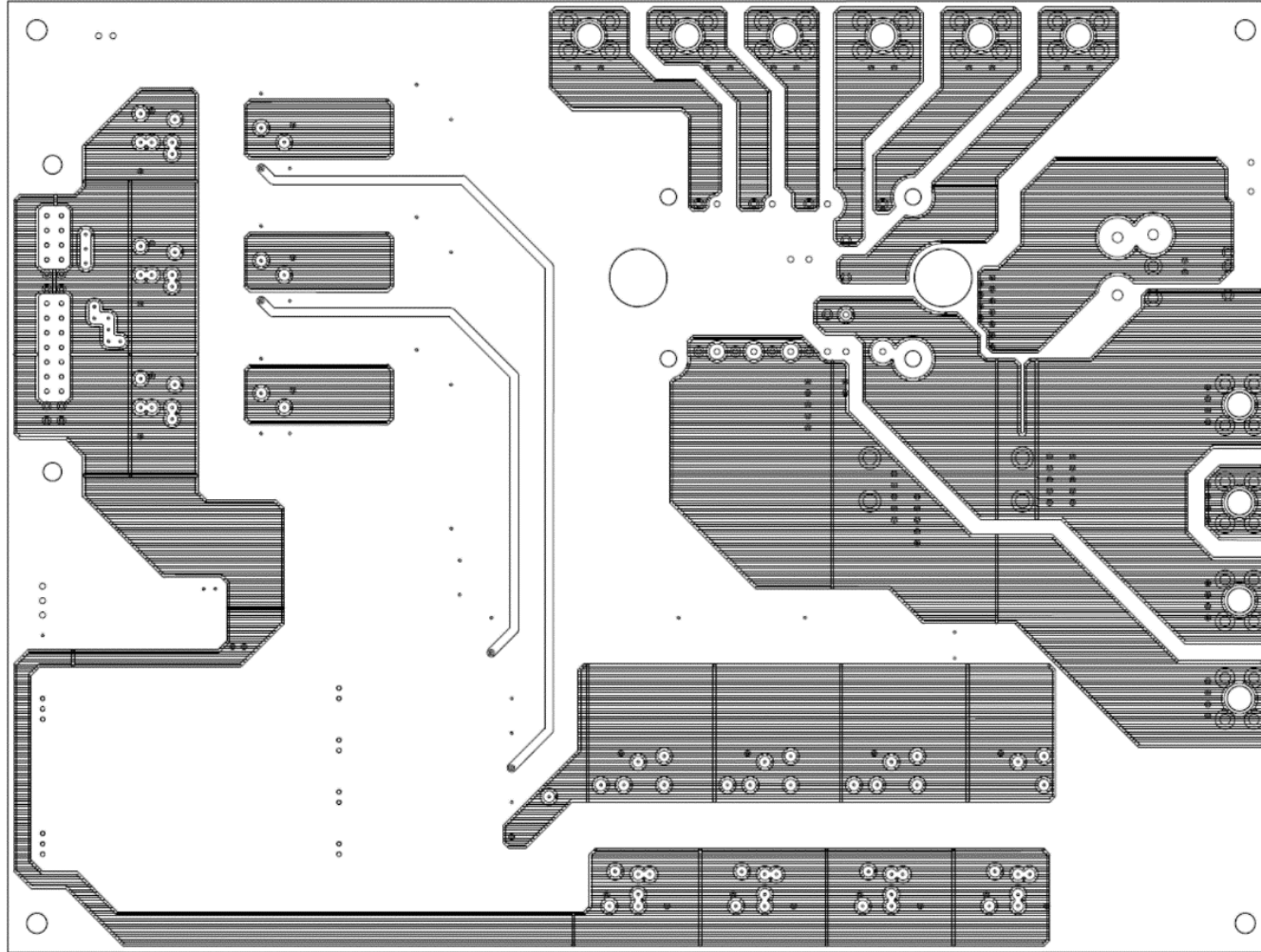
(Top Silkscreen Layer)



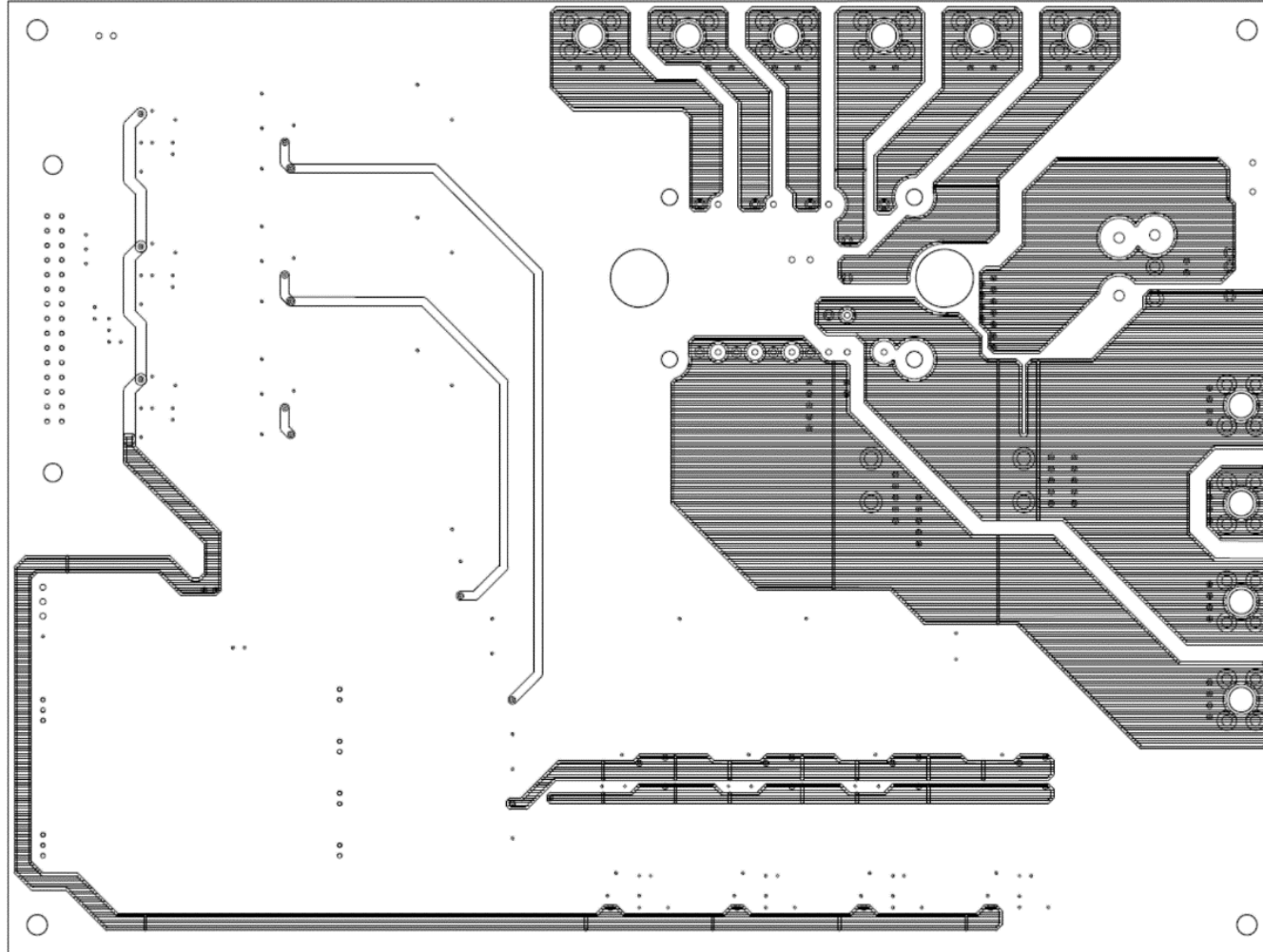
(Top Solder Resist Layer)



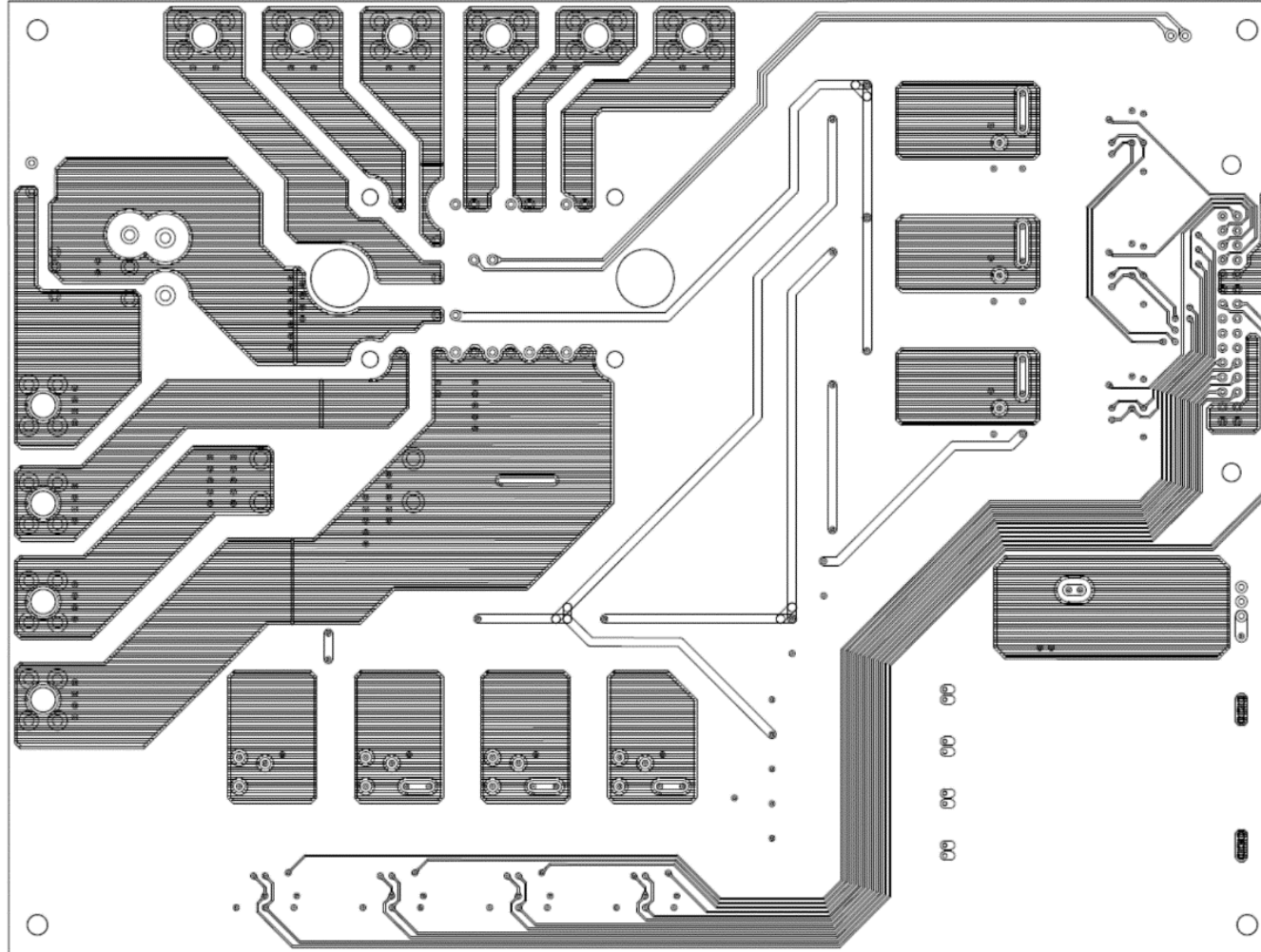
(Top Layer)



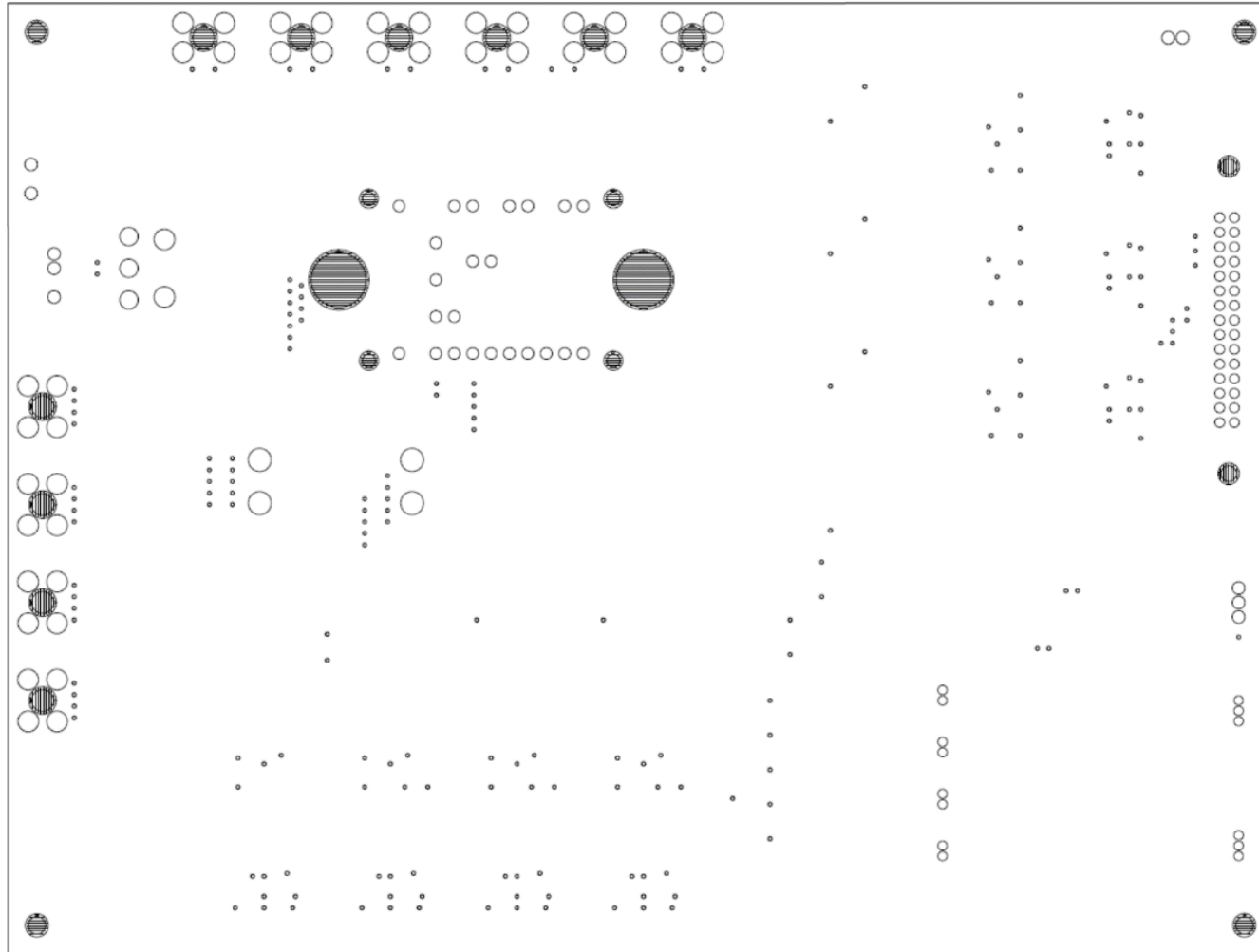
(Layer 2)



(Layer 3)

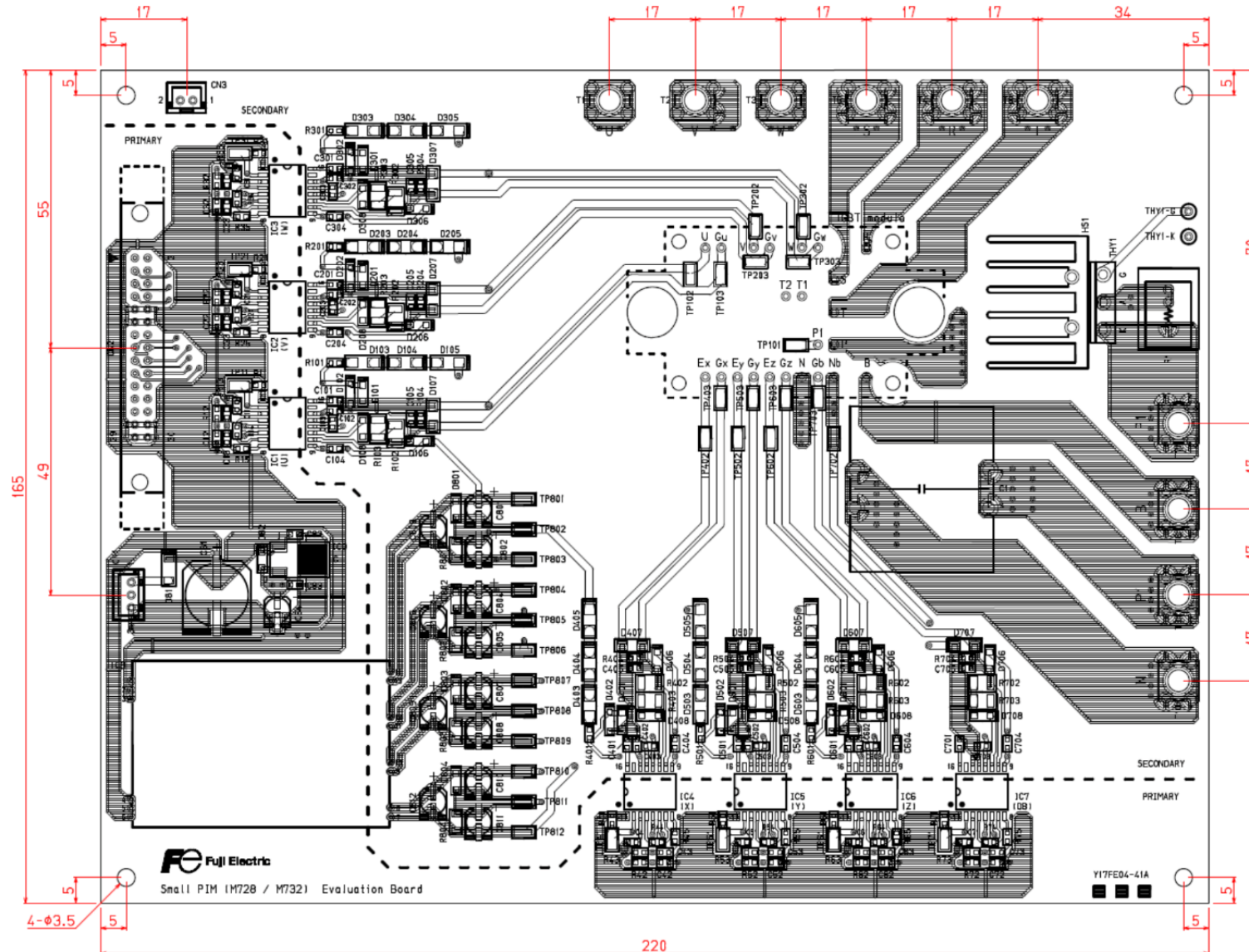


(Bottom Layer)



(Bottom Solder Resist Layer)

Dimensions of PCB Layers



This evaluation board can be ordered via a representative at our company or one of our dealers. CAD-data and gerber-data for this evaluation board are also available on request.

If you don't know the contact address, please request through our website:
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For more information, please visit our website: www.fujielectric.com/products/semiconductor/

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